FILLING THE VOID

Beach town fixes failed storm drain

By Angus W. Stocking

When passersby reported strange smells near the intersection of Brookhurst and Hamilton in Huntington Beach, Calif., city officials looked into the matter. Though the odor was definitely sewage-like, it was discovered that it was emanating from the storm drain system—not the sewer. The best guess was that surrounding marshy areas were contributing enough organic matter to cause the smell.

It was found that the storm drain was infiltrating groundwater heavily laden with hydrogen sulfide gas—enough to foster colonies of *Thiobacillus* bacteria, which consume the gas and excrete sulfuric acid. Some strains of *Thiobacillus* can thrive in acid concentrations as high as 7%.


BEFORE


AFTER

This was bad news; the acid had attacked the concrete storm drain, turning much of it into crumbly calcium sulfate (gypsum). Once established, microbiologically induced corrosion (MIC) can work from the inside out to destroy concrete integrity in just a few months.

Chemical grouting was considered as a repair solution, but in this case, the pipe was too fragile. "This was a 48-in. reinforced concrete pipe storm drain, about 5 in. thick," said Chuck Parsons, general manager at Sancon Eng., the city's contractor for the rehabilitation project. "But in places, the good solid concrete was only an inch thick—the rest was almost entirely crumbly and compromised."

So the city had two challenges: Make a cost-effective, emergency repair on 515 ft of fragile storm drain under 16 ft of soil and 5 ft of groundwater, and prevent further MIC destruction. The solution proposed by Sancon ultimately included four different trenchless technologies and a dewatering method.

Mix & Match Methods

Centrifugally cast concrete pipe (CCCP) was used for the main pipe rehabilitation and cured-in-place pipe (CIPP) was used to repair two compromised laterals. To prevent further MIC damage and groundwater infiltration, two admixtures from ConShield Technologies were used in the centrifugally cast concrete: ConShield, which prevents MIC by making concrete permanently antimicrobial, and Crystal-X, which makes concrete watertight by filling voids in the cured product.

"We usually just use ConShield in sanitary sewers," Parsons said. "But these were 'sewer-like' conditions, if you will, and there was certainly MIC damage, so we're glad ConShield was available. And given the soil conditions and relatively high groundwater, the Crystal-X was also essential in this project."

The CCCP rehabilitation process used, AP/M Permaform's CentriPipe, is built around a precisely controlled spincaster that is inserted into a pipe and withdrawn at calculated speeds. As it is withdrawn, the spincaster sprays thin layers of high-strength cementitious grout that adhere tightly to most substrates. Essentially, it casts a new concrete pipe within the failing pipe that is completely sound structurally, with no seams or joints. Because the new pipe is cast in thin layers, impact is low during each pass, and because the final casting creates a structurally sound pipe with engineered thickness, the failing pipe is not needed for support. As the new concrete adheres tightly to the original pipe, no annular space is created for water flow outside the rehabilitation. The installations are usually quite thin—less than 2 in.—so flow capacity is not significantly affected.

The process was ideal for the Huntington Beach project for several reasons, the most important of which was structural integrity—because the original pipe was failing badly, it could not be relied on to contribute any structural capacity to the final rehabilitation.

CIPP was used to line the laterals. "Big earth voids had formed around the lateral entrances," Parsons said. "They were large, irregular cavities, and we weren't sure how to fill those areas effectively." New CIPP was placed in the laterals, and allowed to project well into the main storm drain. After curing, conventional guniting was used to fill and stabilize the voids around the projecting ends, and the lateral CIPP was trimmed to be flush with the main storm drain. This left a stable, round storm drain, ready for CCCP rehabilitation.

This combination of trenchless solutions is fairly common in large rehabilitation projects; no one method can handle every particular challenge when working underground.

"Once we were actually prepared to [proceed with CCCP], it went very quickly—just a couple of weeks, in fact," Parsons said. "But it took us several weeks to get to that point. Dewatering, in particular, was a significant challenge."

One Way or Another

The first dewatering method used was a series of about 30 well points, drilled into the concrete sidewalk at regular intervals along the pipe and ending near the pipe midline. In ordinary conditions, these well points could be used to pull out enough groundwater to allow CIPP and CCCP work, but water spraying in all sides had to be dealt with first.

"This was very heavy clay soil, and the original pipe was laid in rock bedding," Parsons said. "We just couldn't get enough water to come up out of the bedding and into the wells."

Instead, Sancon drilled three 2-in. holes along the old storm drain invert to get at the rock bed directly. The results were remarkable. "There was so much groundwater pressure that jets of water shot up through the holes," Parsons said. "They were like little geysers, 15 in. high."

To take advantage of that direct access, pumps were used to suck water out of the bedding, and CentriPipe was applied in two phases: First the upstream half of the pipe was dewatered and CCCP applied, then the downstream half was rehabilitated the same way. The work was completed in phases without leaving seams or joints because the cement layers bond well. In this case, third-party engineers said that a total CCCP thickness of less than 1 in. would have been sufficient, but Parsons chose to go thicker—nearly 2 in. in some parts of the pipe—in several passes for extra strength and security.

Whatever It Takes

There were a few other challenges associated with this project—a bus stop had to be moved, for example, and many driveways had to be repaired when work was done. Overall, it was a success, however; Sancon was able to use a mixture of technologies to efficiently and cost-effectively make a near-emergency repair. The newly rehabilitated storm drain is structurally sound and permanently and intrinsically watertight, antimicrobial and MIC resistant. Post-project video inspection confirms that the new pipe is seamless and sound. This is one storm drain that city officials should not have to worry about for many decades. SWS

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